USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2002GA30G

Title: Mid Infrared Water Quality Sensors for the detection of organic pollutants

Project Type: Research

Focus Categories: Water Quality, Surface Water, Toxic Substances

Keywords: in-situ water quality sensor, mid-infrared evanescent wave sensor (MIR-EWS), chlorinated hydrocarbons, pesticides, molecularly imprinted polymers (MIPs), sol-gels, endocrine disrupting compounds (EDCs)

Start Date: 09/01/2002

End Date: 09/01/2004

Federal Funds: $115,822

Non-Federal Matching Funds: $115,822

Congressional District: 5th District John Lewis

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Abstract

Increasing pollution of the world's water resources has stimulated the development of sensor systems capable of screening organic pollutants in the aquatic environment. Especially in urban areas, increasing concentration of volatile organic compounds in surface and ground water threaten primary sources of drinking water. Hence, there is a substantial demand for in-situ, continuously operating and reliable analysis methods emphasizing selective determination of abundant pollutants, such as chlorinated hydrocarbons (CHCs), pesticides or the broad class of endocrine disrupting compounds (EDCs).

The main goal of this research project is the optimization, application and validation of infrared chemical sensor systems for the determination of organic pollutants in the Rottenwood Creek stream, an urban stream located in the metro Atlanta area. This stream is affected by residential, commercial and industrial land use. Hence, this representative site is consistently monitored by U.S.G.S. Water Resources Division, Georgia District. Based upon an already developed prototypes of mid-infrared fiber optic sensors, the project will focus on (1) optimization of the sensor system for monitoring urban water quality, (2) analytical figures-of-merit for the assessment of organic pollutants, such as chlorinated hydrocarbons, aromatic hydrocarbons (BTX) and pesticides, (3) optimization as in-situ water quality sensor for long-term application and (4) validation of results with U.S.G.S. reference measurements. Finally, sensing strategies for the assessment of endocrine disrupting compounds will be developed.

The main objectives are as follows: (i) Development of improved chemical recognition layers for optical waveguides for enhanced stability, recognition properties and sensitivity of the chemical transduction system. Sensing interfaces such as sol-gel thin film coatings and molecularly imprinted polymers are expected to substantially improve the performance of mid-IR sensors in water monitoring applications. (ii) Characterization of the sensing system under simulated real world conditions with samples collected at Rottenwood Creek. Validated reference analysis of this frequently sampled site will enable accurate

determination of analytical figures-of-merit. (iii) An alternative sensing concept for environmental VOC measurements using an IR hollow waveguide gas sensor module combined with a capillary membrane sampler will be tested and validated. We propose a project period of two years; the research will be performed at the Georgia Institute of Technology.

The expected results include the development of optical sensing techniques for molecule-specific, reliable and continuous in-situ determination of selected organic pollutants in surface waters, including the option of simultaneous quantitative multicomponent analysis based on spectroscopic sensing systems. This will satisfy the urgent need for fast and reliable monitoring systems that meet the requirements of simultaneously measuring several organic pollutants in the aquatic environment. Upon success, these results will be a valuable addition to the database of the National Water-Quality Assessment (NAWQA) program and a step towards continuous assessment of pollutant concentrations. Since the application of in-situ sensor systems is of high importance to the general public in order to ensure drinking water quality, a wide range of applications can be anticipated based on the sensors and chemical recognition technologies developed in this project.